Maryland Climate Bulletin
April 2022

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Maryland
State
Climatologist
Office

Summary

April 2022 was largely colder and slightly wetter than normal in average, when compared with the 1991-2020 climatology. These conditions appeared after warm and dry conditions strengthened from February to March. Regional differences showed that while the state had large areas with temperatures below normal, some southern counties experienced above normal temperatures. The southern counties of Somerset and Worcester had above normal mean, maximum, and minimum temperatures, but above normal maximum temperatures reached Wicomico, Dorchester and the southern tips of Saint Mary's and Calvert counties. On the other hand, a tongue of above normal precipitation extending to the southwest and south from Cecil County and along the coastal plains was flanked with below normal precipitation to the west and south. This above normal precipitation over the northeast of the state reached values comparable to the precipitation year-to-year variability. Drought conditions at the end of April 2022 seem to be easing from the previous month widespread abnormally dry conditions according to the drought monitor maps. Statewide temperatures and precipitation were very far away of the extremes in the historical 1895-2021 record, however they were above their mean and median values.

Contents

1.   Introduction

This bulletin is issued by the Maryland State Climate Office once per month in order to indicate in a brief format the most recent monthly surface climatic conditions in the state. Maryland is a state of great geographic diversity with miles of streams and rivers, beaches, coastal flatlands and wetlands, hills, valleys and mountains. This range of physiographic features, together with the land and water distribution and the placement of the state within the continental U.S., contribute to a comparatively wide range of climatic conditions thus the importance of their monitoring. This bulletin is addressed to all Marylanders so they can stay current with the latest climate conditions impacting their lives.

The monthly surface climate conditions for April 2022 are presented via maps of a set of variables such as mean surface air temperature, maximum surface air temperature, minimum surface air temperature, total precipitation, and their anomalies, that are complemented with drought conditions for the state, as given by the U.S. Drought Monitor (Sections 3). Statewide averages in April 2022 are contrasted against the historical record via box and whisker plots and scatter plots (Sections 4). Then statewide and climate division averages for the month are contrasted against each other via scatter plots (Section 5). Ancillary information at statewide, climate divisions and county levels are given via tables and plots, and via maps in Appendices A-D.

2.   Data

Surface air temperature and total precipitation data in this report are from the following sources:

- NOAA Monthly U.S. Climate Gridded Dataset at 5km horizontal resolution (NClimGrid – Vose et al. 2014), which are given in a *preliminary* status, and available at:

  https://www.ncei.noaa.gov/data/nclimgrid-monthly/access/
  Data downloaded on 5/11/2022

- NOAA Monthly U.S. Climate Divisional Dataset (NClimDiv – Vose et al. 2014), which is available, in a *preliminary* status (v1.0.0-20220505), at:

  https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
  Data downloaded on 5/11/2022

The drought conditions map is from the U.S. Drought Monitor site and available at:

https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Some useful notes are the following.

About the anomalies. Anomalies for a given month (i.e. April 2022) are the difference of the monthly values with respect to the long-term mean of the 30 months (i.e. Aprils) in the period 1991-2020; this 30-year mean is known as the climate normal, or just the climatology for short. When a value exceeds its climatological value, it is usually referred as an above normal (e.g., warmer than normal or wetter than normal) anomaly, or positive anomaly, while when the value is smaller than its climatological value, it is referred as a below normal (e.g., colder than normal or dryer than normal) anomaly, or negative anomaly.

About NOAA's Climate Divisions. The term "climate division" refers to one of the 8 divisions in the state that represent climatically homogeneous regions, as determined by NOAA:

https://www.ncei.noaa.gov/access/monitoring/dyk/us-climate-divisions

These regions are the following:

- Climate Division 1: Southeastern Shore. It includes the counties of Somerset, Wicomico and Worcester.
- Climate Division 2: Central Eastern Shore. It includes the counties of Caroline, Dorchester and Talbot.
- Climate Division 3: Lower Southern. It includes the counties of Calvert, Charles and St. Mary's.
- Climate Division 4: Upper Southern. It includes the counties of Anne Arundel and Prince George's.
- Climate Division 5: Northeastern Shore. It includes the counties of Kent and Queen Anne's.
- Climate Division 6: North Central. It includes the counties of Baltimore, Carroll, Cecil, Frederick, Harford, Howard, and Montgomery, as well as the city of Baltimore.
- Climate Division 7: Appalachian Mountains. It includes the counties of Allegany and Washington.
- Climate Division 8: Allegheny Plateau. It includes Garrett County.
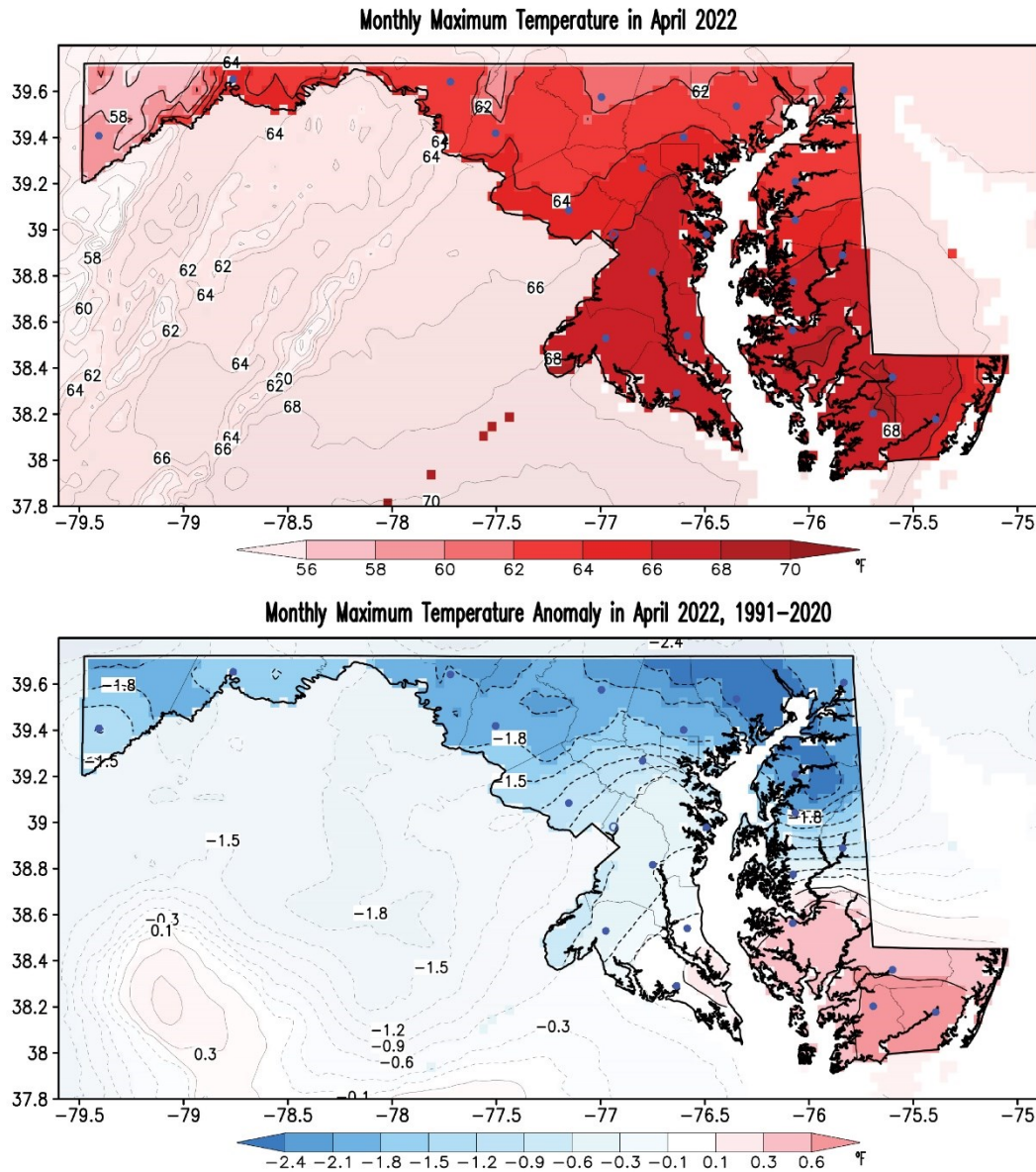
3.   April 2022 Maps

A.   Mean Temperatures
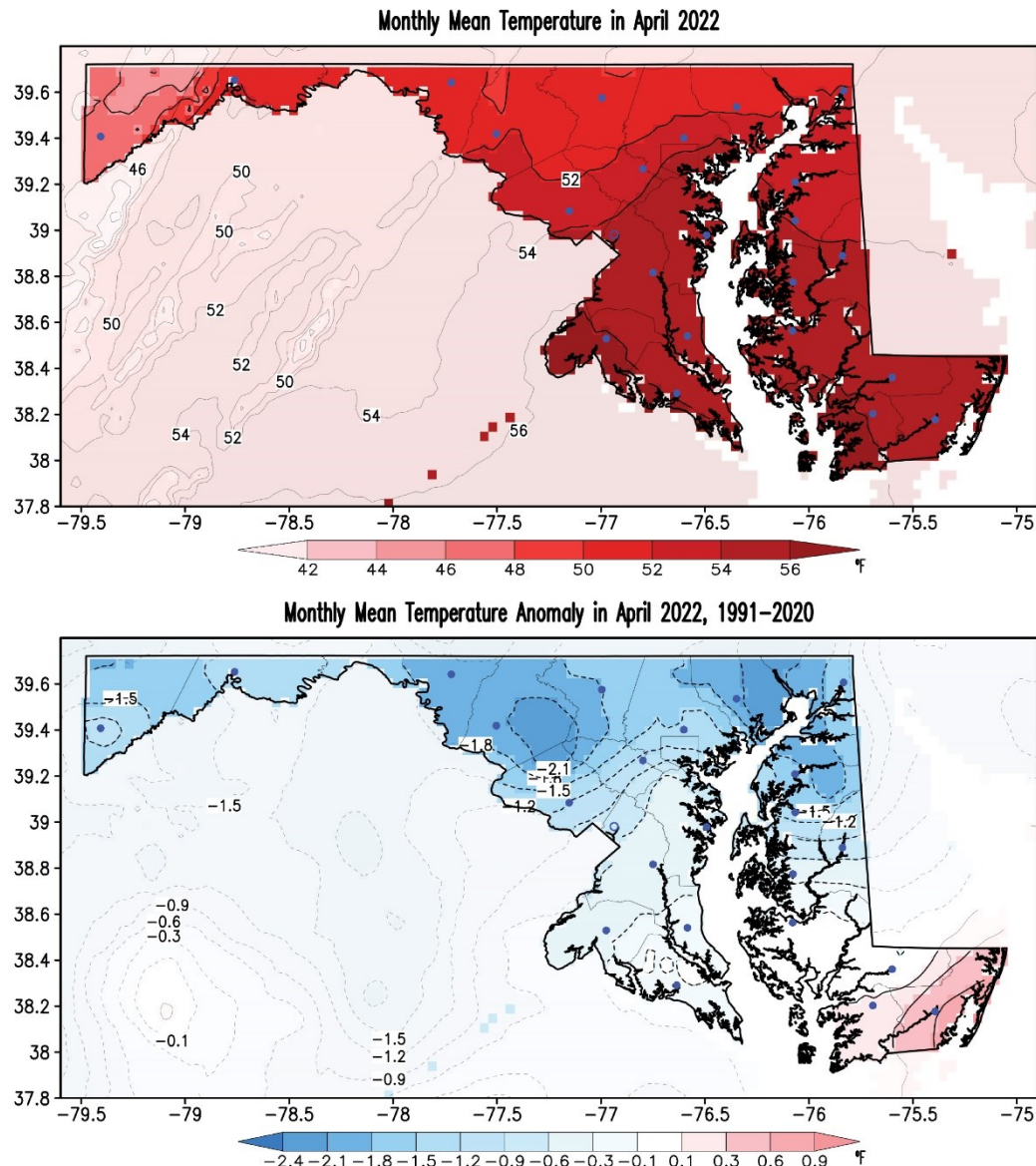
Figure 1. Mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in April 2022. Temperatures are given in °F according to the color bars. Red shading in the anomaly map shows above normal conditions.   Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly mean temperatures in April 2022 increased from south to north. Temperatures along the coastal plains of the eastern and western shores were warmer (~54-56°F) than over the North Central climate division (~52°F), the Allegany and Washington counties (~51°F) and Garrett County (~46°F). However, the mean temperatures over the majority of the state were colder than normal, especially over the northern counties of Frederick and Harford (-2.1°F). Near normal conditions appeared to the south over Dorchester and Wicomico counties and above normal over Somerset and Worcester counties; appendices A and B show the area-averaged values. Maximum anomalies did not surpass the regional year-to-year variability though (Appendix D).

B.   Maximum Temperatures

Figure 2. Maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in April 2022. Temperatures are given in °F according to the color bars. Red shading in the anomaly map shows above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly mean maximum temperatures in April 2022 had the same structure than the mean temperatures with maximum values over the coastal plains (~66-68°F) and minimum values over western Maryland (~58°F). Maximum temperatures over large portions of the state were also smaller than the climatology with maximum negative anomalies over the northeastern counties of Harford and Kent (-2.4°F) and maximum positive anomalies over the Southeastern Shore climate division (0.3-0.6°F). Anomalies are inferior to the year-to-year variability (Appendix D).
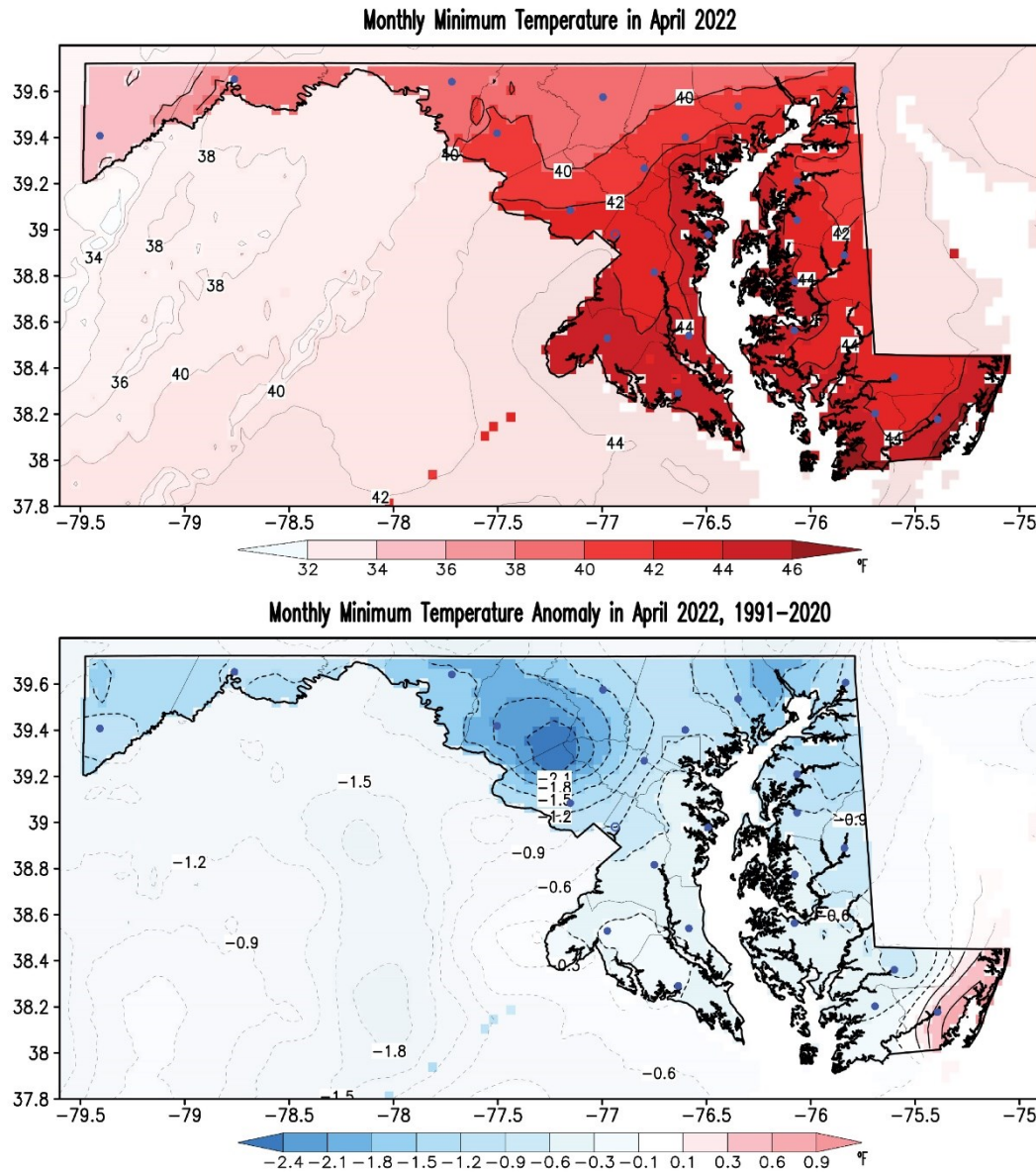
C.   Minimum Temperatures

Figure 3. Minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in April 2022. Temperatures are given in °F according to the color bars. Blue/red shading in the anomaly map shows below/above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly mean minimum temperatures in April 2022 reached minimum values over Garrett County (~34°F) and maximum values along the coasts of the Chesapeake Bay (~44°F). As in the case of the mean and maximum temperature anomalies, the minimum temperatures were below the climatological values of April everywhere except for a small region over Worcester County. The largest deviation from the climatology (-2.4°F) was reached over the meeting area of Montgomery, Frederick, Carroll and Howard counties. These anomalies were comparable to the year-to-year variability (Appendix D).

D.   Precipitation
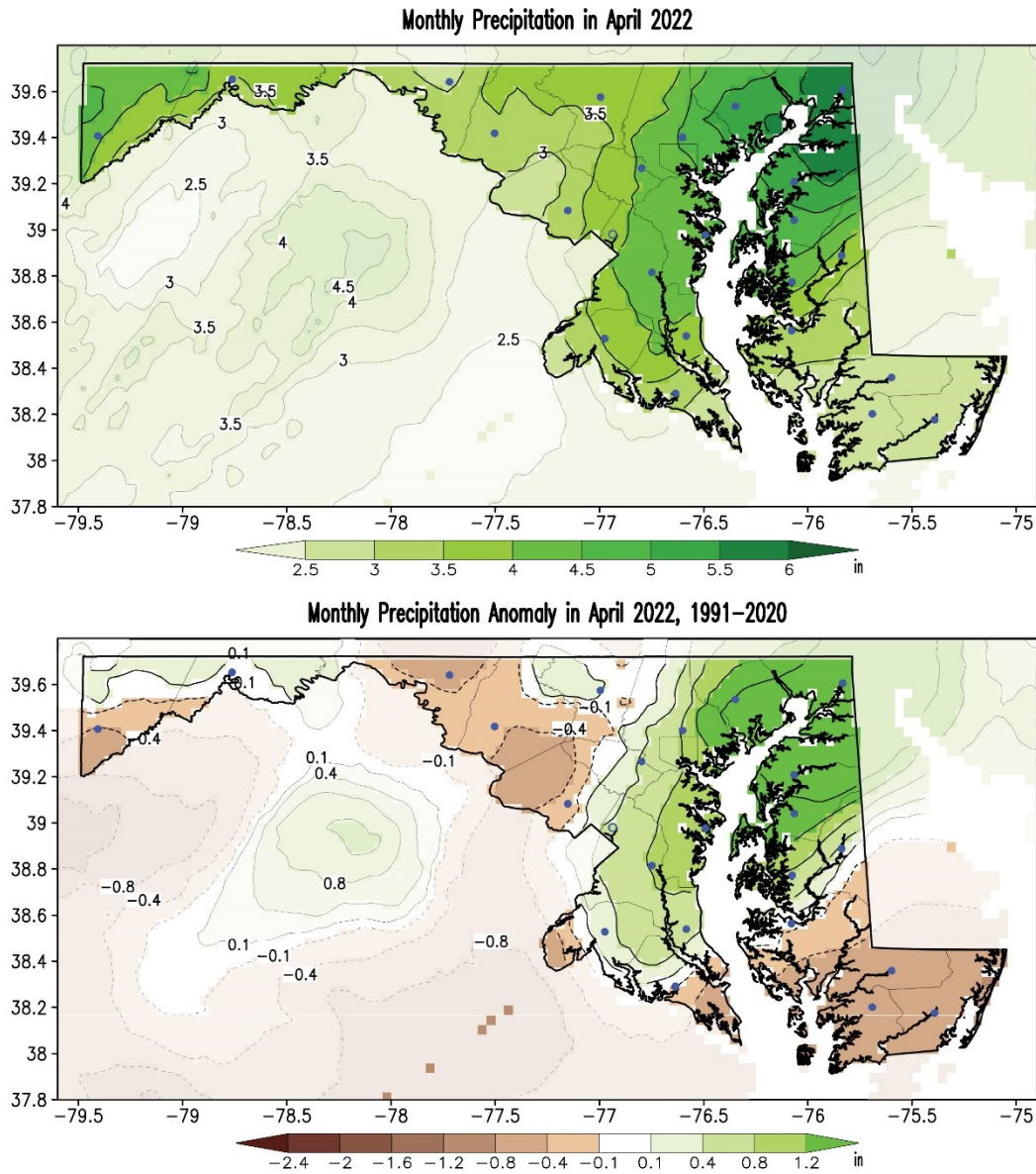

Figure 4. Precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in April 2022. Precipitation units are given as inches according to the color bars. Brown/green shading in the anomaly map shows below/above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly total precipitation in April 2022 shows a distinctive structure with a tongue of maximum precipitation (~5.5 in) emanating from Cecil County toward the southwest along the coastal plains of the Chesapeake Bay, and a secondary maximum over Garrett County. This structure is highlighted in the anomalies with positive anomalies extending from Cecil County toward the southwest and south of the Bay and flanked by negative anomalies to the west and southeast counties. The largest positive anomalies over the northeast of the state exceed the year-to-year variability (Appendix D).

E.   Drought

U.S. Drought Monitor
Maryland

May 3, 2022
(Released Thursday, May. 5, 2022)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	39.09	60.91	2.78	0.00	0.00	0.00
Last Week 04-26-2022	39.08	60.92	2.78	0.00	0.00	0.00
3 Months Ago 02-01-2022	97.75	2.25	0.00	0.00	0.00	0.00
Start of Calendar Year 01-04-2022	55.15	44.85	0.00	0.00	0.00	0.00
Start of Water Year 09-28-2021	100.00	0.00	0.00	0.00	0.00	0.00
One Year Ago 05-04-2021	91.93	8.07	0.00	0.00	0.00	0.00

Intensity:

None
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. For more information on the
Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

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USDA   NDMC   NOAA

droughtmonitor.unl.edu

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on May 3, 2022.

Drought conditions at the end of April 2022 seem to be easing from the previous month widespread abnormally dry conditions according to the drought monitor maps. The anomalous increase in precipitation over the northeastern counties helped on this regard but the anomalous decrease in precipitation to the west and south of the state are sustaining the drought conditions over these regions.

# 4. April 2022 Statewide Averages in the Historical Record

A. Box and Whisker Plots
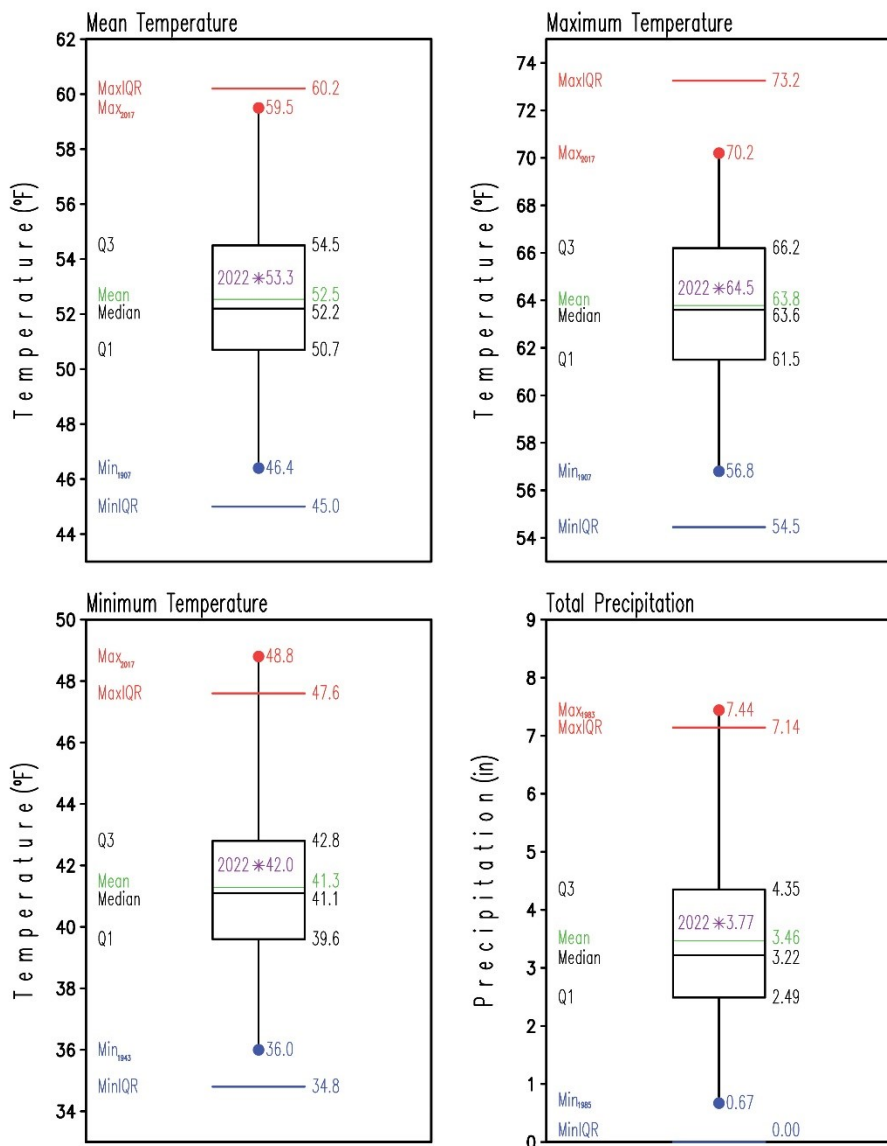
Figure 6. Box and Whisker plots of Maryland statewide mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures and total precipitation (lower right) in April for the period 1895-2021. Conditions in April 2022 are represented by the label and asterisk in purple within the boxes. Statistics for the period 1895-2021 are labeled at the left side of each box and whisker plot and their values at their right. The mean is the green line within the box, while the median is the black line within the box. The lower (Q1) and upper (Q3) quartiles, indicating the values of the variable that separate 25% of the smaller and larger values respectively, are the lower and upper horizontal black lines of the box respectively. The minimum and maximum values in the period are marked by the blue and red dots at the end of the whiskers; the year of occurrence is shown as a subscript to their labels. The blue and red horizontal lines represent extreme values defined by Q1-1.5×(Q3-Q1) and Q3+1.5×(Q3-Q1), respectively.

It is interesting to note that conditions in April 2022, in spite of the extension of the negative temperature anomalies with respect to the current climate normal, are above the long-term mean and median from the historical 1895-2021 record but far away from the extremes.
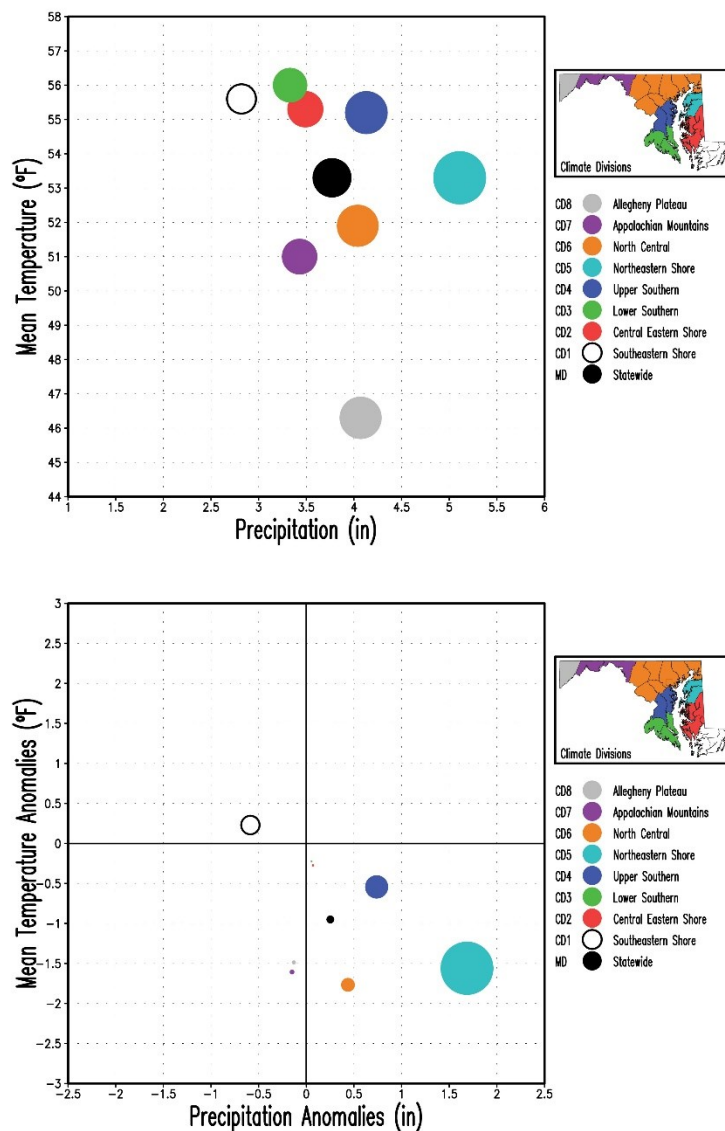
B. Scatter Plots
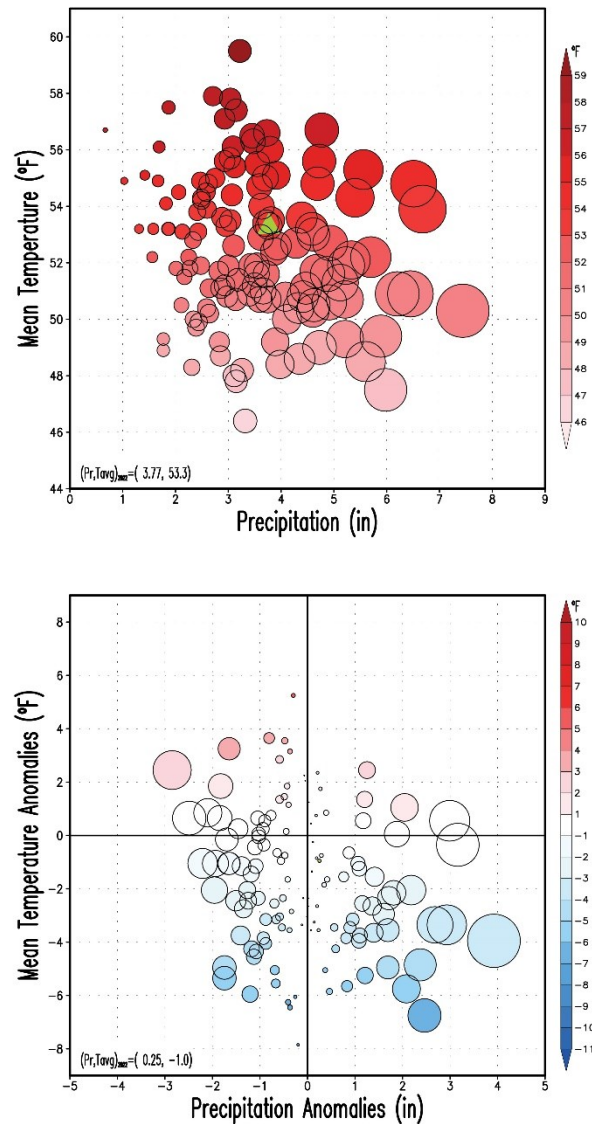
Figure 7. Scatter plot of averaged Maryland statewide mean surface air temperature vs total precipitation in April for the period 1895-2022. Upper panel shows the April mean temperature and total precipitation, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation on record (7.44 in in 1983, top panel) and by the maximum precipitation anomaly (3.92 in in 1983, bottom panel). The red shading of the circles in the top panel denotes temperatures above 32°F, and the blue/red shading of the circles in the bottom panel denotes below/above climatology. April 2022 is marked by the yellow/green filled triangle.

The statewide total precipitation and mean temperature of 3.77 in and 53.3°F, as also indicated by the box and whisker plots, are within the data cloud of the historical record of 128 years. The statewide anomalies of 0.25 in and -1.0 °F indicate a wet and cold anomalous April 2022. The ranking of the temperatures and precipitation in April 2022 within the historical record at state, climate division and county level are displayed in the tables in Appendix A.

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5. April and FMA 2022 Climate Divisions Averages
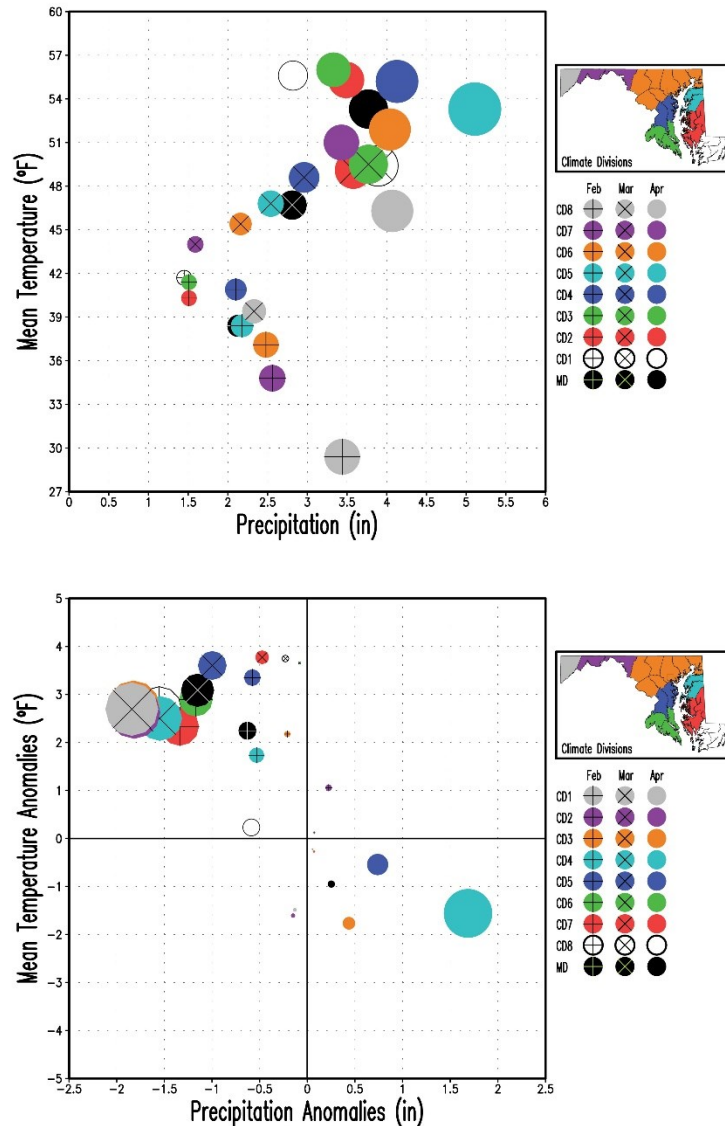
A. April 2022 Scatter Plots

Figure 8. Scatter plot of averaged Maryland statewide and Climate Divisions (CD#) mean surface air temperature vs total precipitation for April 2022. Upper panel shows the mean temperature and total precipitation, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (5.11 in in CD5, top panel) and by the maximum precipitation anomaly (1.69 in in CD5, bottom panel) among the nine regions. Note that the color of the filled circles corresponds to the color in the Climate Divisions according to the inset map.

It stands out that the Allegany Plateau climate division (CD8) was the coldest with mean temperatures below 50°F and that the divisions along the western and eastern shores (CD1-CD4) were the warmest. However, except by the Southeastern Shore climate division (CD1) the rest were colder than normal. The Southern climate division, and those to the north and west of the state (CD7 and CD8) were drier than normal. The values of the surface variables and their anomalies at state, climate division and county level are displayed in Appendix B bar graphs.

B.   February-March-April 2022 Scatter Plots

Figure 9. Scatter plot of averaged Maryland statewide and Climate Divisions (CD#) mean surface air temperature vs total precipitation for February, March and April 2022. Upper panel shows the mean temperature and total precipitation, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (5.11 in in CD5 in April, top panel) and by the maximum precipitation anomaly (|-1.84| in in CD8 in March, bottom panel) among the nine regions. Note that April is displayed with filled circles only, while March and February are displayed with superposed multiplication and addition signs respectively.

Mean temperatures and precipitation increased in general in the state from February to April in this 2022. However, it is clear that April experienced colder and wetter anomalies than in the previous two months. This happened after the antecedent month of March strengthen the warmer and drier than normal conditions of February.

Appendix A. April 2022 Tables: Statewide, Climate Divisions and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)	Region	Total Precipitation (in)	Rank (#)
Statewide	53.3	80	Statewide	3.77	85
Climate Division 1	55.6	98	Climate Division 1	2.82	47
Climate Division 2	55.3	89	Climate Division 2	3.49	71
Climate Division 3	56.0	90	Climate Division 3	3.33	67
Climate Division 4	55.2	87	Climate Division 4	4.13	94
Climate Division 5	53.3	69	Climate Division 5	5.11	110
Climate Division 6	51.9	67	Climate Division 6	4.04	89
Climate Division 7	51.0	65	Climate Division 7	3.43	80
Climate Division 8	46.3	62	Climate Division 8	4.07	78
Allegany	50.6	66	Allegany	3.60	81
Anne Arundel	55.4	87	Anne Arundel	4.30	94
Baltimore	52.3	74	Baltimore	4.30	88
Baltimore City	54.6	85	Baltimore City	4.40	93
Calvert	55.6	87	Calvert	3.70	80
Caroline	54.4	84	Caroline	3.80	81
Carroll	50.8	64	Carroll	3.60	73
Cecil	51.8	64	Cecil	5.50	114
Charles	56.1	88	Charles	3.30	67
Dorchester	55.8	92	Dorchester	3.10	55
Fredrick	51.4	66	Fredrick	3.30	66
Garrett	46.3	61	Garrett	4.00	75
Harford	51.6	59	Harford	5.10	105
Howard	52.6	76	Howard	3.70	78
Kent	53.1	68	Kent	5.30	114
Montgomery	53.0	69	Montgomery	3.10	64
Prince George's	55.1	86	Prince George's	4.00	92
Queen Anne's	53.6	72	Queen Anne's	4.90	108
Saint Mary's	56.0	90	Saint Mary's	3.10	57
Somerset	56.1	96	Somerset	2.80	45
Talbot	55.3	87	Talbot	4.10	89
Washington	51.3	64	Washington	3.10	65
Wicomico	55.5	96	Wicomico	2.90	48
Worcester	55.3	103	Worcester	2.70	42

Tables A1. Mean surface air temperature (left) and total precipitation (right) at statewide, climate division and county levels in April 2022. Temperature is given in °F and precipitation in in. The rank is the order that the variable in April 2022 occupies among the 128 Aprils after the 128 values have been arranged from the lowest to the highest value by using the standard competition ranking method. The closer to 128 is the rank, the larger the value of the surface variable is in the record.

B. Maximum and Minimum Temperatures

Region	Maximum Air Temperature (°F)	Rank (#)	Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	64.5	78	Statewide	42.0	80
Clim. Division 1	66.7	102	Climate Division 1	44.5	93
Clim. Division 2	66.9	91	Climate Division 2	43.6	85
Clim. Division 3	67.2	84	Climate Division 3	44.7	90
Clim. Division 4	66.3	80	Climate Division 4	44.1	85
Clim. Division 5	63.9	57	Climate Division 5	42.8	80
Clim. Division 6	63.1	63	Climate Division 6	40.8	71
Clim. Division 7	63.2	62	Climate Division 7	38.7	61
Clim. Division 8	57.9	59	Climate Division 8	34.6	59
Allegany	63.1	63	Allegany	38.1	60
Anne Arundel	66.2	82	Anne Arundel	44.6	89
Baltimore	63.4	63	Baltimore	41.2	81
Baltimore City	65.2	77	Baltimore City	43.9	84
Calvert	66.6	85	Calvert	44.5	85
Caroline	66.4	80	Caroline	42.5	85
Carroll	62.1	57	Carroll	39.4	68
Cecil	62.2	54	Cecil	41.4	74
Charles	67.6	81	Charles	44.6	91
Dorchester	67.4	98	Dorchester	44.1	84
Fredrick	62.8	65	Fredrick	39.9	60
Garrett	58.0	62	Garrett	34.7	62
Harford	62.4	49	Harford	40.9	72
Howard	64.2	76	Howard	41.0	76
Kent	63.3	54	Kent	42.9	79
Montgomery	64.3	71	Montgomery	41.7	71
Prince George's	66.6	80	Prince George's	43.6	86
Queen Anne's	64.3	63	Queen Anne's	42.9	80
Saint Mary's	67.1	93	Saint Mary's	44.9	86
Somerset	67.1	104	Somerset	45.1	91
Talbot	66.3	86	Talbot	44.3	83
Washington	63.3	64	Washington	39.3	61
Wicomico	67.5	102	Wicomico	43.5	90
Worcester	65.8	102	Worcester	44.8	98

Tables A2. Maximum (left) and minimum (right) surface air temperatures at statewide, climate division and county levels in April 2022. Temperature is given in °F. The rank is the order that the variable in April 2022 occupies among the 128 Aprils after the 128 values have been arranged from the lowest to the highest value by using the standard competition ranking method. The closer to 128 is the rank, the larger the value of the surface variable is in the record.

Appendix B. April 2022 Bar Graphs: Statewide, Climate Divisions and Counties
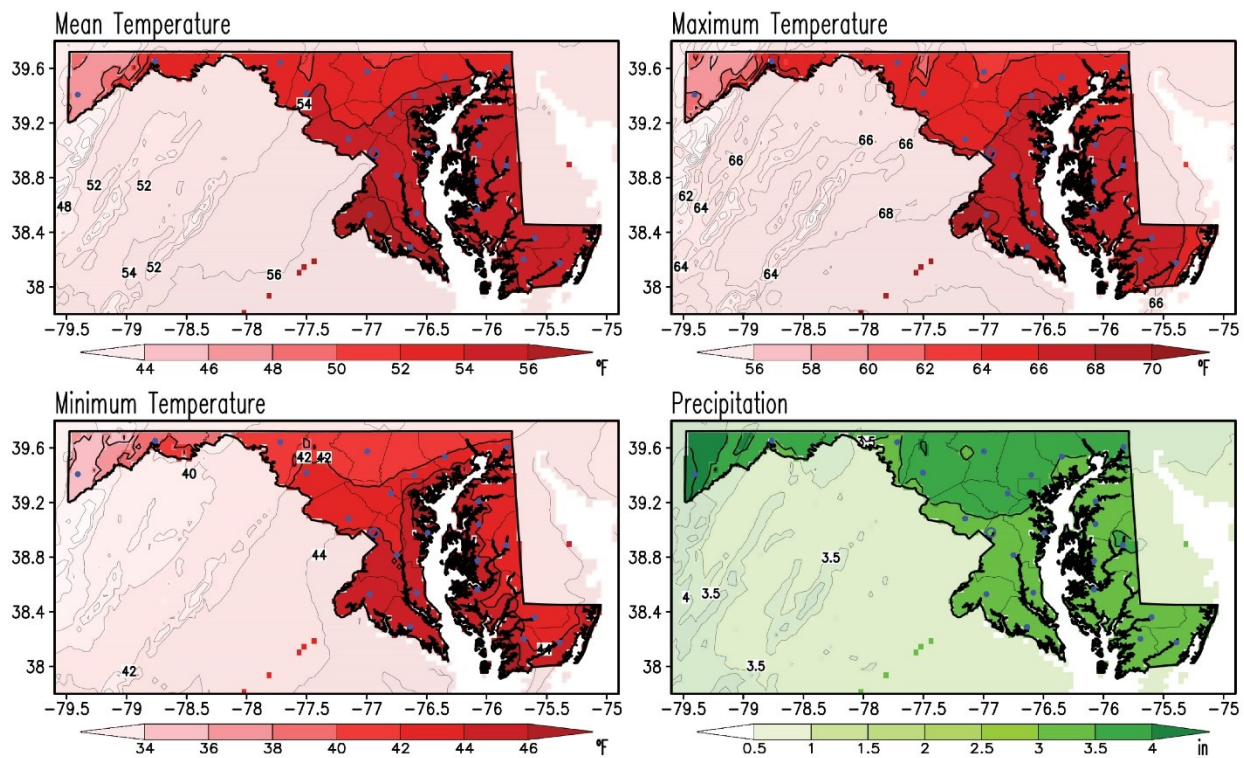
A.   Temperatures and Precipitation
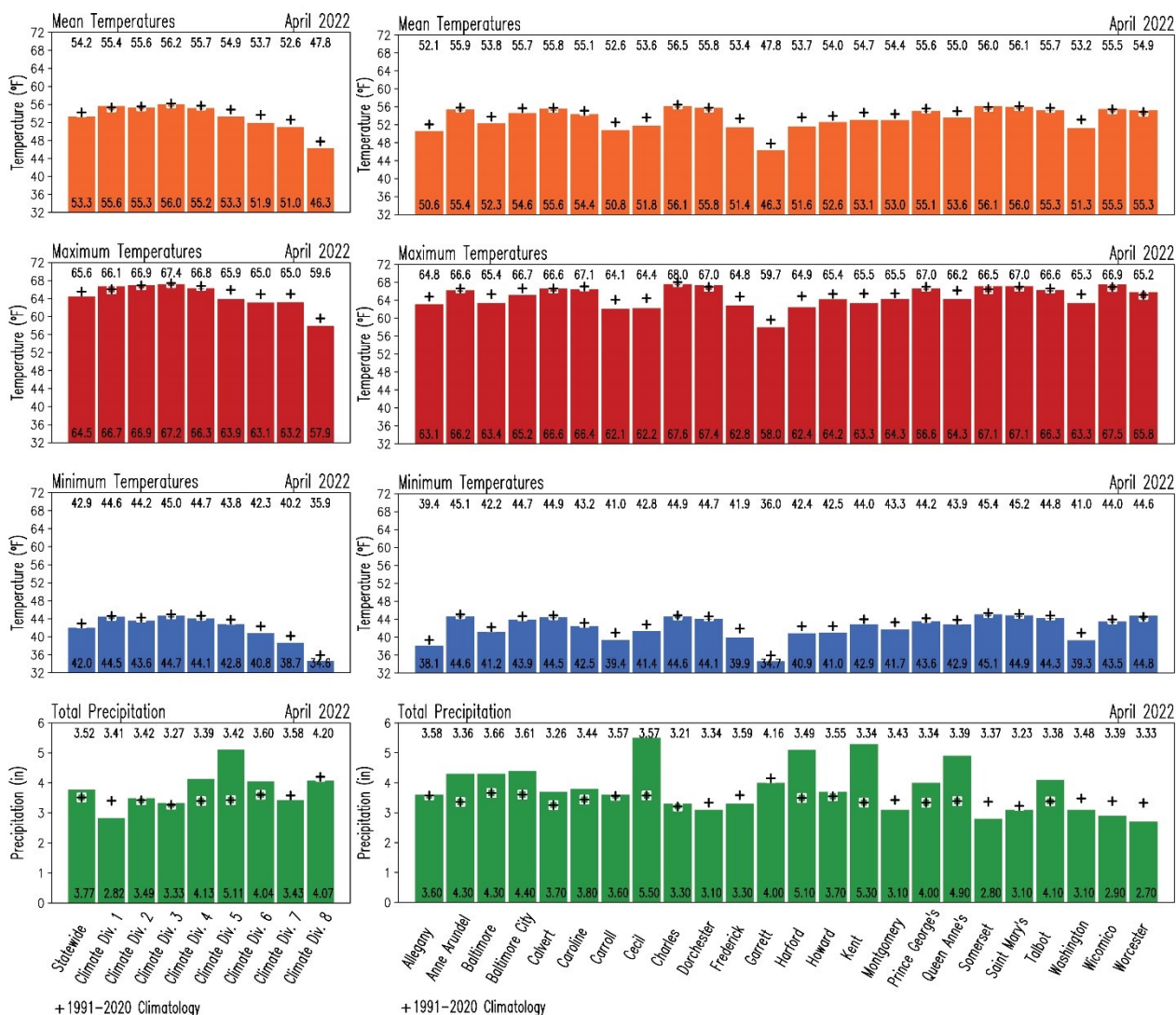
Figure B1. Area-averaged surface variables in Maryland in April 2022. Color bars represent the variables as follows: mean surface air temperature (orange, °F), maximum surface air temperature (red, °F), minimum surface air temperature (blue, °F) and total precipitation (green, in) at statewide and climate divisions (left column), and at county (right column) level. The numbers at the base of the bars indicate the magnitude of the variable in April 2022. For comparison, the corresponding 1991-2020 climatological values for April are displayed as black addition signs, and their magnitude are shown at the top of the panels.

B. Temperature and Precipitation Anomalies
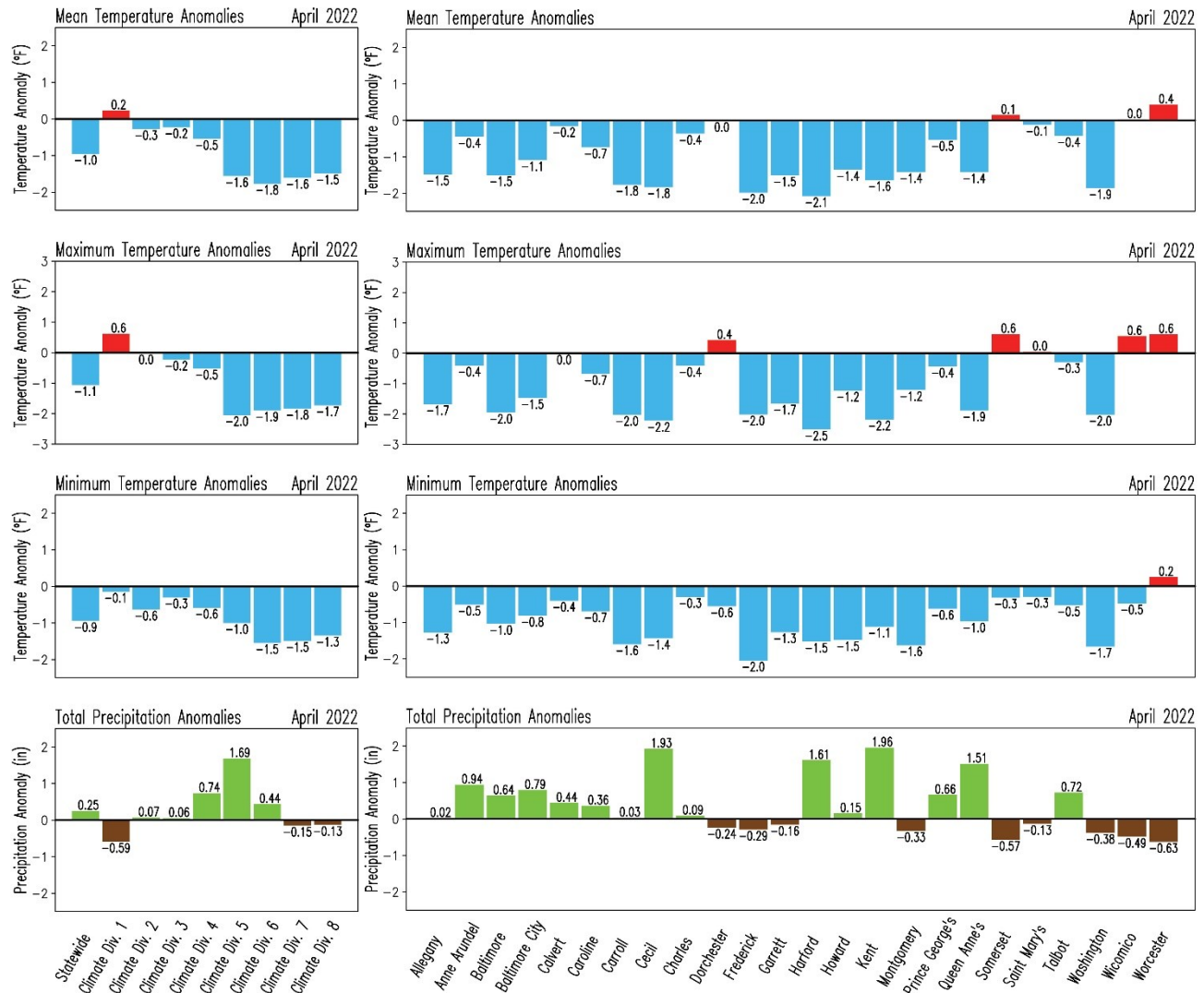
Figure B2. Area-averaged anomalies of the surface variables in Maryland in April 2022. Anomalies are with respect to the 1991-2020 climatology. Red and blue colors represent positive and negative anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and minimum surface air temperature (third row from top) while green and brown colors indicate positive and negative anomalies in total precipitation (bottom row) at statewide and climate divisions (left column), and at county (right column) level. The numbers outside of the bars indicate the magnitude of the anomaly in April 2022. Units are °F for the temperatures and in for precipitation.

# Appendix C. April 1991-2020 Climatology Maps

Figure C1. April climatology of the mean, maximum and minimum surface air temperatures and total precipitation for the period 1991-2020. Temperatures are given in °F and precipitation is in inches according to the color bars. This is the current climate normal against the April 2022 are compared with to obtain the April 2022 anomalies. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Weather and climate are closely related, but they are not the same. Weather represents the state of the atmosphere (temperature, precipitation, humidity, wind, sunshine, cloudiness, etc.) and ocean (sea-level, sea surface temperature, etc.) at any given time, while climate refers to the time-average of the weather elements when the average is over long periods. If the averaging period is long enough we can start to characterize the climate of a particular region.

It is customary to follow the World Meteorological Organization (WMO) recommendation and use a 30-year period for the average. The 30-year averaged weather data is traditionally known as Climate Normal (Kunkel and Court 1990), which is updated every ten years (WMO 2017). The establishment of a climate normal or climatology is important as it allows one to compare a specific day, month, season, or even another period normal with the current normal. Such comparisons characterize anomalous weather and climate conditions, climate variability and change, and help define extreme weather and climate events (Arguez et al. 2012).

Appendix D. April Standard Deviation and April 2022 Standardized Anomalies Maps
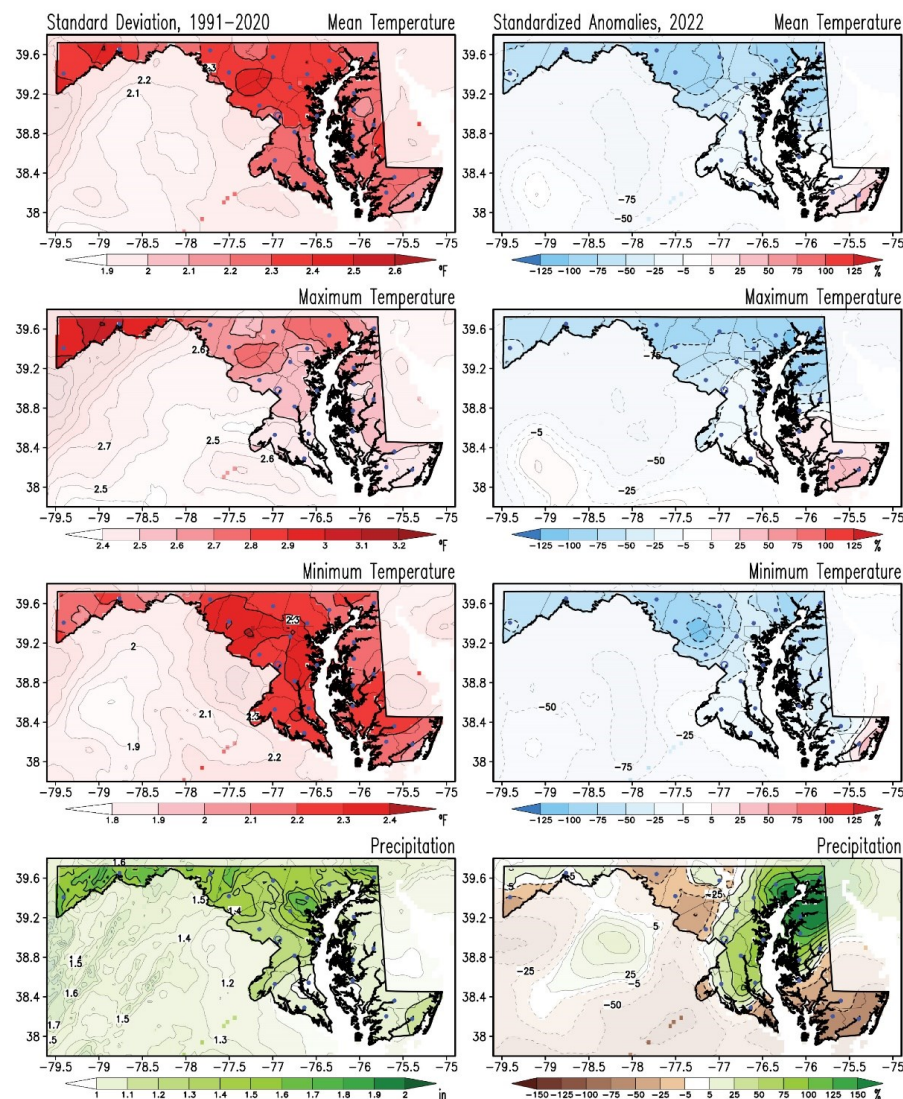
Figure D1. Standard deviation in April and standardized anomalies of temperatures and precipitation in April 2022. Standard deviations for mean, maximum and minimum surface air temperatures and precipitation are obtained for the period 1991-2020 (left column). Anomalies in April 2022 (right column) are obtained as percentage of the standard deviations. The standard deviations in temperatures are given in °F and those in precipitation are in inches according to the color bars. Standard deviation is a measure of the year-to-year variability. The standardized anomalies are obtained by dividing the raw anomalies (from Figures 1,to 4) by the standard deviation (from left column panels) and multiplying that ratio by 100, so units are in percent (%). Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

The standard deviation is a measure of the year-to-year, or interannual, variability of a climate variable. In this case the standard deviation is calculated for the same period as the climatology. Anomalies sometimes are compared against that variability in order to identity extremes in the climate record. When the anomalies are divided by the standard deviation they are named *standardized anomalies*.

References

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